

**The Claimed Invention Is:**

1. A low-voltage micro electrical mechanical (MEM) switch, the low-voltage MEM switch comprising:

a contact bridge;

5 first and second microstrips, each microstrip having an impedance of about 50 <sup>112, not</sup>

Ohms, the first microstrip being electrically isolated from the second microstrip;

a cantilever arm supporting the contact bridge, the cantilever arm having an end portion, an open state, and a closed state, the contact bridge being spaced from the microstrip at a distance of about 12  $\mu\text{m}$  or greater when the cantilever arm is in the open state and the contact bridge providing electrical communication between the first and second microstrips when the cantilever arm is in the closed state;

10 an electrically conductive coil opposing the first end, wherein the electrically conductive coil moves the cantilever arm from the open state to the closed state when a voltage of about 5 Volts or less are applied across the electrically conductive coil; and

15 a housing enclosing the cantilever arm, first and second microstrips, and electrically conductive coil, the housing having a height of about 4 mm or less, and the housing not being hermetically sealed.

20 2. A low-voltage micro electrical mechanical (MEM) switch, the low-voltage MEM switch comprising:

a cantilever arm having first and second end portions;

a contact bridge connected to the cantilever arm and positioned between the first and second end portions;

first and second microstrips, the first microstrip being electrically isolated from the second microstrip; and

5 an electrically conductive coil opposing the first end, wherein the electrically conductive coil moves the cantilever arm between an open state and a closed state, the contact bridge providing electrical communication between the first and second microstrips when in the closed state.

10 3. The low-voltage MEM switch of claim 2 wherein the distance between the contact bridge and the microstrip when the MEM switch is in an open state is about 12  $\mu\text{m}$  or greater.

4. The low-voltage MEM switch of claim 3 wherein the distance between the contact bridge and the microstrip when the MEM switch is in an open state is in the range of about 12  $\mu\text{m}$  and about 2 mm.

15 5. The low voltage MEM switch of claim 3 wherein the cantilever arm, contact bridge, microstrip, and electrically conductive coil are enclosed in a housing, and the housing is not hermetically sealed.

20 6. The low voltage MEM switch of claim 3 wherein the cantilever arm, microstrip, and electrically conductive coil are enclosed in a housing, the housing having a depth of about 4 mm or less.

7. The low-voltage MEM switch of claim 6 wherein the cantilever arm, microstrip, and electrically conductive coil are enclosed in a housing, the housing having a first lateral dimension of about 4 mm or less and a second lateral dimension of about 4 mm or less.

8. The low-voltage MEM switch of claim 6 wherein:

the housing includes a substrate and a cover; and

the cantilever arm, microstrip, and electrically conductive coil are mounted on a substrate and positioned underneath the cover.

5 9. The low-voltage MEM switch of claim 8 wherein the substrate is formed from a laminate and the microstrip is mounted directly on the substrate.

10. The low-voltage MEM switch of claim 2 wherein the coil is energized and moves the cantilever arm between the open and closed states when the coil is energized with a signal having a voltage of about 5 Volts or less.

10 11. The low-voltage MEM switch of claim 2 wherein the coil is energized and moves the cantilever arm between the open and closed states when the coil is energized with a signal having a current of about 10 mA or less.

12. The low-voltage MEM switch of claim 2 wherein the microstrip has an impedance of about 50 Ohms when the cantilever arm is in the closed state.

15 13. The low-voltage MEM switch of claim 2 wherein the contact bridge is formed from an electrically conductive material attached to the cantilever arm.

14. The low-voltage MEM switch of claim 2 wherein the cantilever arm is formed at least in part with an electrically conductive material, and the cantilever arm forms the contact bridge.

20 15. A low-voltage micro electrical mechanical (MEM) switch, the low-voltage MEM switch comprising:

a cantilever arm;

first and second microstrips, the first microstrip being electrically isolated from the second microstrip; and

means for moving the cantilever arm between a first position wherein the first and second microstrips and contact bridge form a closed circuit and a second position wherein the microstrips form an open circuit.

16. The low-voltage MEM switch of claim 15 wherein the means for moving the cantilever arm includes an electrical coil, the coil opposing the cantilever arm.

17. The low-voltage MEM switch of claim 16 wherein the coil is formed with wire that is 25  $\mu\text{m}$  gauge or smaller.

18. The low-voltage MEM switch of claim 17 wherein the arm has first and second ends, the coil is positioned adjacent the first end, and the cantilever arm rotates around the second end.

19. A method of closing a circuit using a low-voltage micro electrical mechanical (MEM) switch, the method comprising:

15 providing a low voltage MEM, the low voltage MEM including a cantilever arm having first and second ends, a contact bridge connected to the cantilever arm and positioned between the first and second ends, an electrical path having first and second portions, and an electrical coil within a housing having a height less than about 4 mm;

20 applying a voltage of about 5 Volts or less across the electrical coil;

in response to applying the voltage of about 5 Volts or less across the electrical coil, pivoting the cantilever arm around the first end, thereby moving the contact bridge a distance in the range of about 12  $\mu\text{m}$  and about 2 mm

from a first position wherein the contact bridge forms an open circuit between the first and second portions of the electrical path to a second position wherein the contact bridge forms a closed circuit between the first and second portions of the electrical path; and

5 conducting an electrical signal along the first portion of the electrical path, through the contact bridge, and then along the second portion of the electrical path.

20. A method of closing a circuit using a low-voltage micro electrical mechanical (MEM) switch, the method comprising:

10 providing a low voltage MEM, the low voltage MEM including a cantilever arm, a contact bridge connected to the cantilever arm, an electrical path having first and second portions, and an electrical coil;

applying a voltage of about 5 Volts or less across the electrical coil; and

in response to applying the voltage of about 5 Volts or less across the electrical

15 coil, moving the cantilever arm from a first position wherein the contact bridge is not in electrical contact with both the first and second portions of the electrical path to a second position wherein the contact bridge is in electrical contact with both the first and second portions of the electrical path.

20 21. The method of claim 20 wherein further comprising:

passing an electrical current of about 10 mA or less through the electrical coil simultaneously with the step of applying a voltage of about 5 Volts or less across the electrical coil.

22. The method of claim 20 wherein providing a low voltage MEM, the low voltage MEM including a cantilever arm, a contact bridge connected to the cantilever arm, an electrical path having first and second portions, and an electrical coil includes:

providing a low voltage MEM, the low voltage MEM including a cantilever arm,

5 a contact bridge connected to the cantilever arm, an electrical path having first and second portions, and an electrical coil positioned within a housing having a depth of about 4 mm or less.

23. The method of claim 22 wherein providing a low voltage MEM, the low voltage MEM including a cantilever arm, a contact bridge connected to the cantilever arm, an electrical path having first and second portions, and an electrical coil includes:

10 providing a low voltage MEM, the low voltage MEM including a cantilever arm,

a contact bridge connected to the cantilever arm, an electrical path having first and second portions, and an electrical coil positioned within a housing having a first lateral dimension of about 5 mm or less and a second lateral dimension of about 5 mm or less.

24. The method of claim 20 further comprising:

conducting an electrical signal along the first portion of the electrical path, through the contact bridge, and then along the second portion of the electrical path, the electrical signal having a frequency that is about 30 GHz or higher.

25. The method of claim 20 wherein moving the cantilever arm includes:

moving the contact bridge a distance of about 12  $\mu\text{m}$  or greater.

26. The method of claim 25 wherein moving the contact bridge a distance of about 12  $\mu\text{m}$  or greater includes:

moving the contact bridge a distance in the range of about 12  $\mu\text{m}$  and about 2 mm.

27. The method of claim 26 wherein the cantilever arm has first and second ends, the  
5 first end being fixed in a stationary position, the second end being positioned proximal to  
the electrical coil, and the contact bridge being positioned between the first and second  
ends; further wherein moving the cantilever arm includes:

pivoting the cantilever arm around the first end until the contact bridge directly  
contact the first and second portions of the electrical path.